FINAL REPORT FOR NAGW-5133

"Large Scale Currents as a Coronal Heating Source"

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The objective of this research project was to study a large set of active regions observed with the SXT telescope on Yohkoh and with the Haleakala Stokes Polarimeter at the Mees Solar Observatory at the University of Hawaii. Average active region X-ray luminosities were measured with the SXT, and the Stokes Polarimeter data were used to construct vector magnetograms of the corresponding active regions. The X-ray luminosities can then be compared with spatial integrals of many quantities computed from the vector magnetograms. This final report describes the work completed under NAGW-5133.

Work Completed

Magnetic fields are believed to play the primary role in heating the Sun's corona, yet after decades of research, the heating mechanism(s) remain poorly understood. We (Fisher *et al.* 1996, 1997) employ a new approach to studying coronal heating by comparing the spatially integrated radiative output of the corona in active regions with "global" magnetic variables computed from vector magnetograms. Our strategy is to examine as diverse a sample of active regions as possible, and see which, if any, global magnetic quantities provide a good predictor for coronal heating.

X-ray luminosities are measured with the SXT telescope on Yohkoh (Tsuneta *et al.* 1991 *Sol. Phys.* **136**, 37) using the thin aluminum filter; vector magnetograms were taken with the Haleakala Stokes Polarimeter (Mickey *et al.* 1985 *Sol. Phys.* **97**, 223) at the University of Hawaii's Mees Solar Observatory. Global (spatially integrated) magnetic quantities in our study include the total unsigned magnetic flux, the integral of the absolute vertical current density, the integral of the square of the vertical magnetic field, and the integral of the square of the transverse components of the magnetic field.

We find that the X-ray luminosity L_x is best correlated with the total unsigned magnetic flux Φ (see Figure 1). While other global quantities also

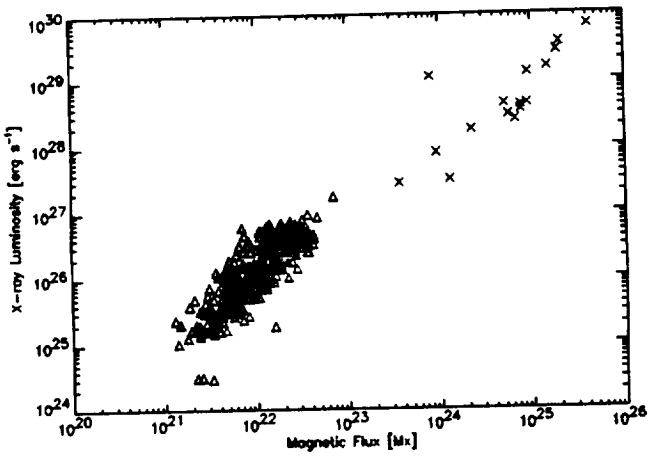

Figure 1. X-ray Luminosity of Active Regions as a function of total unsigned magnetic flux Φ. Triangles show the 333 active region measurements in our study; also shown (crosses) are X-ray luminosities of nearby active G, K, and M dwarf stars as a function of their total magnetic flux (from field strengths and filling factors given by Saar [1996]).

correlate with the X-ray luminosity, we find that these correlations can be explained entirely by their own correlations with Φ, and when these correlations are accounted for, there is no significant residual correlation of L_x with any other variables. We also find the specific flux dependence of L_x is consistent with Longcope's "Minimum Current Corona" picture of coronal heating via reconnection near separator loops. We are preparing a paper for publication in the *Astrophysical Journal* describing this work.

Publications supported from NAGW-5133:

Fisher G. H., Longcope D. W., Metcalf T. R., and Pevtsov A. A. "Coronal Heating in Active Regions as a Function of Global Magnetic Variables", B.A.A.S. **188**, no. 33.04. (1996)

Fisher, G. H., Longcope D. W., Metcalf T. R., and Pevtsov A. A. *Ap. J.*, in prep. (1997)

THIS [illegible] VERIFY THAT THE SMITH & WAGNER INFO IS STILL CURRENT BECAUSE THE HQ "X-500" DIRECTORY WAS DOWN ON FRIDAY, AND STAYED DOWN ALL WEEKEND. DW WAGNER PROBABLY OK — IT'S SMITH THAT CHANGES ETC. -Dw

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Acc. to D. Weldon, (11/14/97 Conversation) Larry Smith no longer in the loop. Final Reports now go to Mildred Garner at GSFC

Dave says these addresses still current.